Arizona, which were exhibited by Professor Edward S. Morse and Sylvester Baxter during the recent Congress of Americanists at Berlin. This discovery confirms the American origin of the bean. The plant called *phaselos, faseolus*, etc., in antiquity, is, according to Körnicke, *Dolichos chinensis*, or a variety of the species *D. melanophthalmos*. Mr. Wittmarck has found also seeds of the pumpkin in ancient Peruvian burials, and concludes that the pumpkin is originally an American plant. The so-called pumpkins of the Bible are, according to Ascherson and Magnus, melons (*Cucumis Chate L.*), and so are those represented on ancient Egyptian paintings. On the other hand, Gray and Trumbull have proved that before the arrival of the Europeans, pumpkins were used as far north as northern New York.

ELECTRICAL NEWS.

Electrical Lines of Force.

THIS subject was brought before the members of the Royal Institution, London, some years ago by Mr. Gordon; and recently a lecture was delivered on the same subject at the institution by Professor A. W. Rücker, an abstract of which appears in *Nature* of March 7. In the interval a considerable amount of work has been done upon it, both in England and Germany, and many experiments have been devised to illustrate it. Some of the more striking of these, though of great interest to the student, are rarely or never shown in courses of experimental lectures. The lecturer and Mr. C. V. Boys, F.R.S., last year devised a set of apparatus which has made the optical demonstration of electrical stress comparatively easy, and most of the results obtained by Kerr and Quincke can now be demonstrated to audiences of a considerable size. Before discussing this portion of his subject, the lecturer introduced it by an explanation of principles on which the experiments are founded.

Magnetic lines of force can easily be mapped out by iron filings, but the exhibition of electrical lines of force in a liquid is a more complex matter. In the first place, if two oppositely electrified bodies are introduced into a liquid which is a fairly good non-conductor, convective conduction is set up. Streams of electrified liquid pass from the one to the other. The highly refracting liquid phenyl thiocarbamide appears to be specially suitable for experiments on this subject. If an electrified point is brought over the surface, a dimple is formed, which becomes deeper as the point approaches it. At the instant at which the needle touches the liquid the dimple disappears, but a bubble of air from the lower end frequently remains imprisoned in the vortex caused by the downward rush of the electrified liquid from the point. It oscillates a short distance below the point, and indicates clearly the rapid motions which are produced in the fluid in its neighborhood. When the needle is withdrawn, a small column of liquid adheres to it. This effect is, however, seen to greater advantage if a small sphere about five millimetres in diameter is used instead of the needle-point. When this is withdrawn, a column of liquid about five millimetres high and two millimetres in diameter is formed between the sphere and the surface. A similar experiment was made by Faraday on a much larger scale with oil of turpentine; and he detected the existence of currents, which are in accord with the view that the unelectrified liquid flows up the exterior of the cylinder, becomes electrified by contact, and is repelled down its axis. In view of this explanation, and the movements assumed can be clearly seen in the phenyl thiocarbamide, the performance of the experiment on a small scale is not without interest. The possibility of the formation of such violent up-and-down currents in so small a space must depend upon a very nice adjustment between the properties of the liquid and the forces in play. It is obvious that such movements of the liquid must be a disturbing element in any attempt to make the lines of electric force visible.

Again: if a solid powder be suspended in a liquid into which electrified solids are introduced, it tends to accumulate round one of the poles. This subject has been investigated by W. Holtz. Sometimes the powder appears to move in a direction opposed to that in which the liquid is streaming. Sometimes two powders will travel towards different poles.

If powdered antimony sulphide be placed in ether, it settles at the bottom of the liquid; and if either two wires insulated with glass up to their points, or two vertical plates, be used as electrodes, on exciting them slightly the solid particles arrange themselves along the lines of force. If the electrification be increased, they cluster round the positive pole. On suddenly reversing the electrification by means of a commutator, they stream along lines of force to the pole from which they were previously repelled. Other methods of obtaining the lines of force have been devised. They can, for instance, be shown by crystals of sulphate of quinine immersed in turpentine.

The tendency of the lines of force to separate one from the other was illustrated by Quincke's experiment. A bubble of air is formed in bisulphide of carbon between two horizontal plates. It is in connection with a small manometer, and when the plates are oppositely excited, the electrical pressure acting at right angles to the lines of force, being greater in the liquid than in air, compels the bubble to contract.

Kerr's experiments depend upon the fact, that, since the electrical stress is a tension along the lines of force, and a pressure at right angles to them, a substance in which such a stress is produced assumes a semi-crystalline condition in the sense that its properties along, and perpendicular to, the lines of force are different. Light is therefore transmitted with different velocities, according as the direction of vibrations coincides with, or is perpendicular to, these lines; and the familiar phenomena of the passage of polarized light through crystals may be imitated by an electrically stressed liquid.

The bisulphide of carbon used must be dry, and, to make the phenomena clearly visible, it is necessary that the light should travel through a considerable thickness. Thus, to represent the stress between two spheres, elongated parallel cylinders should be used, the axes of which are parallel to the course of the rays of light. These appear on the screen as two dark circles. Between crossed Nicols, the planes of polarization of which are inclined at forty-five degrees to the horizontal, the field is dark until the cylinders are electrified, when light is restored in the space between them.

If parallel plates with carefully rounded edges, and about two millimetres apart, are used, the colors of Newton's rings appear in turn, the red of the third order being sometimes reached. If one plate is convex towards the other, the colors of the higher orders appear in the middle, and travel outwards as the stress is increased. The experiments may be varied by using two concentric cylinders, or two sheets of metal bent twice at right angles to represent a section through a Leyden jar. In the first case a black cross is formed; and in the second, black brushes unite the lower angles of the images of the edges of the plates. By the interposition of a piece of selenite, which shows the blue of the second order, two of the quadrants contained between the arms of the cross become green, and the others red. In like manner the horizontal and vertical spaces between the inner and outer coatings of the "jar" become differently colored.

There are several phenomena connected with the stress in insulators which present considerable difficulties. Thus in a solid it is found impossible to restore the light between crossed Nicols by a uniform electrical field. That the non-uniformity of the field has nothing to do with the phenomenon in liquids, though at first disputed, is now generally admitted. It may be readily proved by means of a Franklin's pane, of which half is pierced into windows. The glow is much weakened by thus removing part of the uniform field, though it is thus made much less uniform.

Again: though most dielectrics, when placed in an electric field, expand, the fatty oils contract. Professor J. J. Thomson has recently pointed out that this indicates that another set of strains are superposed upon those assumed in the ordinary explanations of these phenomena, and by which they may be neutralized or overcome.

In experiments with carbon bisulphide it is necessary to take every precaution against fire. For this purpose the cell which contains the liquid should be immersed in a larger cell; so that if, as sometimes happens, the passage of a spark cracks the glass, the liquid may flow into a confined space. This should stand in a tray

with turned-up edges, and an extinguisher of tin plate should be at hand to place over the whole apparatus. No Leyden jars should be included in the electrical circuit. The difficulties which formerly arose in the exhibition of experiments in statical electricity, owing to the presence of moisture in the air of a lecture-room, are now immensely reduced by the Wimshurst machine, which works with unfailing certainty under adverse conditions. A new and very beautiful machine was kindly lent by Mr. Wimshurst for the purposes of the lecture.

ARC-LAMP FOR INCANDESCENT CIRCUITS. — The Silvey Electric Company, Lima, O., claims to have the only arc-lamp that can be depended on at all times for incandescent circuits. In this lamp it is impossible to cross the carbons or cause a short-circuit. The lamp has a rack feed-rod fed by a mechanism which makes it impossible for the carbons to approach each other more than one two-hundredth part of an inch at a time, thus maintaining the light steady at all times, while it is impossible for the two carbons to drop together. The light may be turned on or off at will, and the company guarantee the lamp to burn perfect upon any system of incandescent lighting, and to not interfere with the incandescent lights. Persons having incandescent machines often want an arc-lamp or two for yards or large open places. This lamp meets this want, and is arranged to burn on the Edison, Mather, Thomson-Houston, United States, and other incandescent machines. It takes the same amount of power as ten incandescent lamps, giving a return of two thousand nominal candle-power. A patent was issued to William L. Silvey, March 5.

DYNAMO-DESIGNING. — At a meeting of the Engineers' Club of St. Louis, March 20, Professor Nipher addressed the club on "Plans of Investigations in Dynamo-Designing." His remarks were illustrated by numerous drawings, and by formulæ and sketches on the blackboard. He explained in detail the principles involved, and showed how, when certain constants for any type of dynamo had been ascertained, the design of dynamo of the same type of any other desired capacity could be readily determined. He had recently made such a calculation for an Edison dynamo, which he used as an illustration. He gave two empirical formulæ for the safe carrying capacity of a wire in ampères. The cost of copper necessary in any dynamo, and the speed at which it could be run, were usually determining factors in the problem. Another important consideration is the resistance which the space around the dynamo offers to the magnetic line. It would be very desirable to have experiments made to determine this resistance for the prominent dynamos now in the market.

THE MAGNETIC ACTION OF DISPLACEMENT CURRENTS IN A DIELECTRIC. — Professor S. P. Thompson read before the Royal Society a few weeks ago an interesting paper on displacement currents. That there is an electric displacement in the dielectric of a condenser when the coatings are charged, and that any variation of this displacement causes effects analogous to those of ordinary electric currents, are points that have been indirectly proved by several experiments, notably those of Hertz. Thompson attempted at first to prove it directly by observing the effect on an astatic needle suspended near the edge of a condenser, of charging the condenser or of discharging it. But, as calculation showed that the effect would be too small to be observed, he adopted a different method. An iron annulus wound with a coil of fine wire was embedded in a layer of paraffine between two glass plates which were coated with tinfoil. The displacement passes through the iron ring, and any changes in the displacement should set up lines of magnetic induction in it; and these would cause currents in the fine wire circuit with which it was wound. The condenser was connected with an induction-coil; the fine wire, with a telephone. When the induction-coil was working, sounds were heard in the telephone, and it is held that this proves the existence of displacement currents. The method is extremely simple and ingenious; but one is led to ask if the reasoning that deduces from the experiment the existence of displacement currents does not depend on assumptions no better proved than the phenomenon experimented on.

PATENTS ON ALTERNATING-CURRENT TRANSFORMERS. — Some months ago the validity of the Gaulard and Gibbs patents in England suffered an adverse decision of the courts, and the decision has just been affirmed by the Court of Appeal. In this country the Gaulard-Gibbs patents are held by the Westinghouse Company; and, although decisions of English courts do not by any means allow us to infer how the same case would be decided here, yet the result could not but be a blow to that company. As an indirect result of the trial, however, the Jablochkoff patents have been brought prominently forward; and as it is understood that the Jablochkoff patents in this country are owned by the United States Electric Lighting Company, and as the United States Company is controlled by the Westinghouse, the position of the latter corporation is not materially weakened by the English decision. M. Jablochkoff had granted him in 1877 a patent, of which one claim read as follows: "The use in apparatus for the production of electric light, of induction-coils, interposed in a primary electric circuit for generating separate and independent currents, to be used for producing electric light in one or more lamps interposed in such secondary circuits substantially as herein described." It is understood that the owners of the English patents have made arrangements with some of the leading electrical manufacturing concerns in that country by which the latter have been granted licenses under the patents.

THE TESLA ALTERNATING-CURRENT ELECTRIC MOTOR. — Almost a year ago Mr. Tesla read before the Institute of Electrical Engineers a paper on alternating-current electric motors, in which he described a motor of his own invention, which embodied several novel and ingenious features. The great novelty of the invention consists in the fact that the revolving armature is not connected with any external source of supply, but has currents induced in its coils by the variations of the magnetic field. The motor attracted a great deal of attention at the time, and its performance was enthusiastically praised. Professor W. A. Anthony made tests of the motor, but the only datum he gave was, that, "at 6,400 alternations, over one horse-power can be obtained at an efficiency of 62 per cent." As the measurement of the efficiency of such a machine would be extremely difficult, embodying some novel methods, and as no details of the methods employed or of the weight or speed of the motor were given, we can hardly consider Professor Anthony's statements as very satisfactory, and now we are again disappointed. A Tesla motor was sent to the Central Institution in London, and we had hoped that some tests would be made and published; but the only information so far obtained is a statement of Professor Ayrton that the motor gave .63 horse-power with 3,720 alternations at a speed of 3,200 revolutions, — quite an impractical speed for a commercial machine. The Tesla motor has been taken up by the Westinghouse Company, and there is no doubt that neither energy, nor money, nor talent are being spared to develop it. There is no doubt that it will work, and there is little doubt that it offers some advantages. At present it labors under the disadvantages of not being applicable with an ordinary alternating-current system, of requiring three wires instead of two, and of being possibly not so light or as efficient as a corresponding continuous-current motor. In a short article on the subject, the London *Electrical Review* concludes: "The weight of material used in a Tesla motor must be several times as much as that necessary for a continuous-current motor to give the same output, rendering such machines very costly. Thus it would appear that alternating-current motors are a long way off from the ideal goal, in spite of the strenuous efforts on the part of some of the smartest people in the world; and we are inclined to think that the solution of the problem may yet have to be sought in an entirely different direction." This is rather gloomy, and is hardly consistent with the fact that the subject has made rapid strides in the last year, and gives promise of an early solution of the whole question.

THE BIRMINGHAM ELECTRIC LOCOMOTIVE. — This locomotive is used for exceptionally heavy tramway work, and was designed to take the place of the steam-engines now in use. The motor weighs a ton, and the current for it is supplied from 100 storage-cells, weighing together four tons and a half. The cells are subdivided into four groups, which can be used either four in parallel, two in series, two in parallel, three in series, or four in series. The motor is suspended beneath the car, and is geared directly to both

of the axles. Some trials were made to determine the tractive force of this locomotive. It was coupled directly to one of the ordinary steam-locomotives of the Birmingham Tramway Company, and set to haul the latter. The brakes on the steam-locomotive were then gradually tightened until it was brought to rest, when the spring balance indicated a pull of a ton and a half; the current through the motor at that time being 200 ampères. Previous trials on the line had shown that the maximum pull was required on a six-per-cent grade, where it amounted to 1,800 pounds: so the electric locomotive has a margin of over 50 per cent of tractive power above that actually required in the ordinary working of the line. While it is to be hoped that the experiments in Birmingham will succeed, yet storage-batteries have hardly reached that state of perfection that they can compete, as far as expense goes, with steam-engines. While it is still a very doubtful question whether they are more economical than horses for street-car work, it would seem a mistake to bring them in direct competition with steam.

The Dimensions of Electrical Units. — Professor Fitzgerald, in a note communicated to the Physical Society of London, calls attention to the fact that the dimensions of the electric and magnetic inductive capacities are the same, being the inverse of a velocity, the one differing from the other only by a numerical coefficient. This, Professor Fritzgerald thinks, is very suggestive, and seems to have been hitherto overlooked. He thinks that the two quantities must be proportional to the reciprocal of the square root of the mean kinetic energy of the ether.

A New Dynamo. — Messrs. Fritsche and Pischon of Berlin have brought out a new wheel-armature dynamo which gives some remarkable results. The armature is built without a core, without cotton insulation, without copper, and without a special commutator construction. It is built up of a lattice-work of iron rods, which are separated by air-spaces, and the rods are prolonged as segments of the commutator. The dynamo is multipolar. The smallest of them gives 50 16-candle-power lamps, at a speed of 240 revolutions: the largest supplies 3,500 lamps at 70 revolutions. They are said to be very efficient, which fact, together with their extreme simplicity, will probably cause their extended adoption.

NOTES AND NEWS.

The Ericsson Coast Defence Company was incorporated at Albany on Friday, March 22, by George H. Robinson, William Williams, Ericsson F. Bushnell, Cornelius S. Bushnell, and Edward S. Innet. The main idea of the company is to manufacture implements for the defence of the American coasts, and to enlist the interest and assistance of the United States Government in the results of the studies and experiments of the late Capt. John Ericsson, who devoted many years and much labor to the subject of our coast defences. The most notable of his inventions in this line is the "Destroyer," a boat built for the destruction of the monitor gunboats. The company claims that the boat has been satisfactorily tested, and believes that it will receive recognition from the present administration. With all the other inventions left by Capt. Ericsson, the Ericsson Coast Defence Company will have nothing to do; that is, with inventions which have nothing to do with the subject of coast defence. There are several of the latter inventions, notably a perfect caloric engine and the sun-motor, which the executors will proceed to patent at once, or at least as soon as they can act in the matter according to law. Owing to the legal advertising made necessary by the conditions of the will, that document cannot be probated before May. Every thing has to be turned into cash, and the necessary delay in communicating with the legatees in Sweden and other parts of Europe will prevent for the present the patenting proposed by the executors. This delay, however, does not affect the operations of the Ericsson Coast Defence Company, which is wholly independent of the will and the legatees.

— The collection of American precious stones, both in the form of crystals and cut stones, which are to be exhibited at the Paris Exposition, Messrs. Tiffany & Co. have decided to place on exhibition on Friday, Saturday, Monday, and Tuesday, March 29 and 30 and April 1 and 2. This collection is one of the finest that has ever been gotten together, and will be in charge of Mr. George F. Kunz, who has devoted considerable time to its preparation.

— In *Nature* of March 7, J. Starkie Gardner writes as follows on the origin of coral islands: "Mr. Murray's concise explanation of the formation of coral reefs and islands presents advantages in more than one respect. It demands no *a priori* assumptions, but begins and ends with that which can be observed, while Darwin's theory requires the preliminary concession of subsidence, which never has been and never perhaps can be observed. It must appear ungracious to question a theory that accords so completely with the natural history of coral islands; but even this theory requires a geological concession, and that is stability. Coral islands, it may be supposed, after all, only differ from other oceanic islands in being crusted over with coral, so that we cannot see their original state; and the question is, whether we can grant such long periods of stability to them, from our experience of other oceanic islands, which are free from coral, and can therefore be observed. Nearly all oceanic islands are volcanic, and it is probable that their elevation coincides more or less with the period of volcanic activity somewhere along their line. It is obvious that coral islands are not formed during this phase, because no theory would then hold good; the peaks would grow through and carry up the coral, which might leave only such small traces of its existence as we find in a single spot in Madeira. It would not be unreasonable to suppose, that, if the expansive and elevating force were withdrawn, the peaks would slowly subside; and that, if there are some lines of elevation, there must be others of subsidence, unless the earth is as a whole growing in bulk. Darwin claims the existence of areas of subsidence, and that these are eminently favorable to coral-growth; and it is quite apparent that if the Island of Madeira were to sink, as it has undoubtedly risen, its last appearance in a coral sea would be as an atoll. We shall never see the interior structure of a stationary or subsiding coral island, and can only look for a re-elevated example with a crust that has been protected from solution whilst dead and submerged, and yet not sufficiently so to mask the core. In submitting geological considerations, I am not questioning any of Mr. Murray's observations, which are in every way admirable, though it does appear to me doubtful whether atolls could increase outwards in deep water on their own talus, in face of the dissolution of dead coral that is claimed to take place in the interior of the lagoons, and yet more so in deeper water."

— We note with pleasure the advancement to the grade of commander in the navy of Commander R. B. Bradford, who for the past few years has had complete control of the various electric-light instalments in our men-of-war and at the different naval stations. The unvarying success that these numerous plants have met with are well-deserved tributes to the abilities of the naval inspector of electric-lighting.

— Marcus M. Hartog, in *Nature*, writing of the inheritance of acquired characters, says, "A very strong *a priori* objection to the line on which most experiments on the inheritance of acquired characters are carried on is the following. These experiments involve mutilation; and a tendency to transmit characters so produced would, considering that every accident or fight produces some slight mutilation, involve the animals in a process of degeneration: hence the tendency to transmit the characters acquired by mutilation would be constantly bred out by natural selection. But a tendency to transmit characters acquired by habit in youth rests on quite another basis, and would tend to the conservation of the race. I do not know if observations have been made on the physique of the offspring of persons engaged in trades where apprenticeship begins before puberty: they would be most valuable. But the following case seems to me to be thoroughly to the point. A. B. is moderately myopic and very astigmatic in the left eye; extremely myopic in the right. As the left eye gave such bad images for near objects, he was compelled in childhood to mask it, and acquired the habit of leaning his head on his left arm for writing, so as to blind that eye; or of resting the left temple and eye on the hand, with the elbow on the table. At the age of fifteen the eyes were equalized by the use of suitable spectacles, and he soon lost the habit completely